ATTACHMENT C

Before the

NATIONAL TELECOMMUNICATIONS AND INFORMATION ADMINISTRATION

Washington, DC 20230

In the Matter of:	)	
	)	
Measurement Plan to Determine the Potential	)	Docket No. 0006232194-0221-02
Interference Impact to Global Positioning System	)	
Receivers from Ultrawideband Transmission	)	
Systems	)	

COMMENTS OF THE U.S. GPS INDUSTRY COUNCIL ON GLOBAL POSITIONING SYSTEM/ULTRAWIDEBAND MEASUREMENT PLAN

The U.S. GPS Industry Council ("the Council"), by its attorneys, hereby provides its comments on the National Telecommunications and Information Administration ("NTIA") Measurement Plan to Determine the Potential Interference Impact to Global Positioning System Receivers from Ultrawideband Transmission Systems ("NTIA Measurement Plan").[1] The Council, at the outset, must acknowledge the extraordinary effort that NTIA has obviously expended in the development of the Measurement Plan. Utilizing limited resources under what the agency acknowledges to be "extremely aggressive" time pressures, NTIA has made a valiant effort to develop a measurement program that is designed to address the numerous significant questions that have been raised as to the impact of emissions from so-called ultrawideband ("UWB") transmission systems into the millions of receivers, including their associated, integrated communications, in hundreds of applications that are utilizing the signals broadcast by the satellites of the U.S. Global Positioning System ("GPS"). These efforts, while necessary, are far from sufficient to provide any basis for making a rational decision on whether a particular type of UWB transmission signal can be operated compatibly with GPS receivers.

In order to devise a measurement program that can provide the sought-after answers regarding UWB interference, it is vital to understand the physical science inherent in regulating spectrum based on the time domain, rather than the current spectrum management by frequency band allocation. Managing the spectrum by time rather than by frequency represents a fundamental paradigm shift. Most of the UWB technology under consideration is pulsed communication. To effectively manage pulsed communication, an infrastructure to manage the time domain aspects of the radio spectrum must be established that allows for the allocation and monitoring of peak power per hundreds of picosecond sampling intervals.

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[1] The Council's comments are provided pursuant to a Notice published in the Federal Register requesting comments on or before August 29, 2000 on the NTIA Measurement Plan. The Plan itself is available from the NTIA home page on the worldwide web. *See* Notice, Request for Comments on Global Positioning System/Ultrawideband Measurement Plan, 65 Fed. Reg. 49544 (August 14, 2000) ("NTIA Notice").

Without an understanding of the physical science of UWB transmission signals, attacking the interference problem on an experimental basis becomes primarily a "hit or miss" proposition. It is only through an understanding of the physical science principles involved that the measurement program will be able to focus in on where the interference problems are likely to occur. The absence of such an understanding simply underscores the impossibility of the task facing NTIA, as one may follow a seemingly appropriate test plan and fail to uncover harmful interference even though it exists. **In any event, electronic measurement instrumentation will provide time domain measurements of repetitive waveforms that will allow the effect of single emitters to be assessed, but will not adequately measure the problems created by multiple emitters in network applications of UWB technology.** [2]

In reviewing the Measurement Plan and the covering NTIA Notice, the Council is compelled to observe that there is an unmistakable inverse correlation between the ability of NTIA to achieve the laudable objectives of the studies it is endeavoring to conduct, and the amount of time allowed it for the design of the study program and the gathering and reporting of the data.[3] NTIA actually concedes the existence of this undesirable relationship,[4] but clearly creates the impression that it believes it has no alternative but to attempt to persevere – even before it gains a full understanding of the basic science of UWB.

The Council has great sympathy for the wholly untenable situation in which NTIA finds itself. The Council remains concerned, however, that the competing pressures that are being brought to bear will lead to errors both of commission and omission in the studies to be done.[5] In

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[2] To the Council's knowledge, in the only known instances where real-time measurements of time domain phenomena have been taken, measurement equipment was utilized by the high energy physics community for the underground nuclear testing program. High-end sample-and-hold oscilloscopes (20 GHz sampling speed) provide a time domain amplitude measurement of single, repetitively applied pulses, but such oscilloscopes do not function in real time, and so are not useful for time domain measurements of aggregate trains of pulses from a variety of different emitters with a variety of interpulse interval codes.

[3] Under the Measurement Plan, NTIA is afforded less than six months to proceed from the development of a measurement plan, through the acquisition of measurement hardware and development of the measurement system, to the performance of the measurements themselves (including modification of procedures as necessary based on measurement experiences) and reduction and analysis of the acquired data. *See* NTIA Measurement Plan at 22 (Table 5). So aggressive is the schedule that only two weeks, right in the heart of the holiday season, are provided between the completion of data acquisition and the transmission of the effort's final report. *Id.*

[4] In the Measurement Plan, NTIA concedes that "this schedule severely limits the scope of these tests, . . . [and] that the estimated completion dates provided in this schedule does [sic] not provide any allowance for unforseen [sic] measurement or analysis anomalies that may arise as the program proceeds." NTIA Measurement Plan at 22. NTIA notes further that "this schedule does not account for the time required to conduct the subsequent analyses with the measurement data acquired and to complete a final report formally documenting the measurement and analyses results." *Id.*

[5] Indeed, under the schedule that NTIA itself already finds stiltingly inflexible, it is telling to note that the submission of a report containing reduced and analyzed data would not occur until nearly two months after the Federal Communications Commission's ("FCC") target deadline of October 31, 2000 for the submission of data and analysis on the impact of UWB transmissions. The October 31, 2000 deadline was tentatively established in the FCC's Notice of Proposed Rule Making on UWB technology. *See Revision of Part 15 of the Commission's Rules Regarding Ultra-Wideband Transmission Systems*, Notice of Proposed Rule Making, FCC 00-163 (released May 11, 2000) ("*FCC NPRM*").

particular, the Council is firmly convinced that the current NTIA Measurement Plan will not adequately address the kinds of impairments that GPS receivers would experience as a result of UWB transmission signals. Furthermore, the current emphasis is on the characterization of GPS receiver implementation, not on the characterization of the infinite variety of UWB waveforms.

In Section I below, the Council provides general comments that are intended to address the most effective use of NTIA's technical resources in making compatibility assessments between UWB and GPS, and urgently requests that these views be taken into account by NTIA and others in positions of responsibility on this issue before unfortunate and perhaps disastrous mistakes are permitted to occur. The NTIA Notice specifically requests public comment on a series of seven questions that NTIA believes will assist it in refining its Measurement Plan.[6] Although the Council is concerned, in the absence of the theoretical background for time domain management, whether the right questions have been asked, the Council nevertheless provides responses to NTIA's questions in Section II below.

I. General Comments

By the very nature of some of the questions asked in the NTIA Notice and from some of the assumptions underlying aspects of the Measurement Plan itself, it is clear that NTIA does not have a complete understanding either of the nature of emissions from UWB transmission systems or what measurement criteria it should use in making its assessments of such emissions.[7] This is to be expected, because UWB emissions can be produced by a wide variety of emitter types with a wide variety of UWB signal signatures, and UWB pulse trains have interpulse intervals which are dithered by a code that makes aggregate effects difficult to define. Indeed, "UWB" is an extremely broad descriptor for a large and relatively heterogeneous class of transmitters that can have a myriad of different interference signatures that depend on the parameters and frequency bands of the applications being considered, and on the unique characteristics of the drivers and antennas of those transmitters. Moreover, UWB transmission systems are best characterized by time domain measurements (i.e., such systems transmit signals that are extremely short or discontinuous – as opposed to continuous – in time, and as a byproduct of uncertainty conditions between time and frequency, the temporal shortness results in wide bandwidths), in contrast with the existing spectrum management framework for continuous signals, whereby specific frequency blocks are allocated to particular radio services and frequency assignments are then made to users within those services.

The FCC and NTIA manage the spectrum infrastructure in the United States, and have only just begun to address the regulatory challenges presented by UWB – an already daunting task that is complicated by the differing interference characteristics of particular UWB applications.[8]

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6 *See* NTIA Notice, 65 Fed. Reg. at 49545.

7 A similar lack of understanding as to the very nature of UWB is patently evident in the *FCC NPRM.*

8 The complexity of the interrelationship between UWB's use of the time domain and the current spectrum management approach around the world generated at least one call (prior to the issuance of the *FCC NPRM*) for a comprehensive study of how, if at all, the two spectrum management domains can be made to co-exist. *See* Concept for a National Research Council, Computer Science and Telecommunications Board Study on Ultra Wideband Technologies. Among the questions to be addressed in the study are the key questions of whether future applications and demands for UWB radio are likely to pose spectrum allocation questions; how might spectrum allocation be

The lack of an established basic science framework makes this task almost impossible. There is some question as to whether either is well equipped at present to address the regulatory challenges posed by UWB.[9] The questions as to how to characterize UWB and its role in the current U.S. frequency management infrastructure are significant and not easily resolved. Clearly, NTIA and the FCC each need to be mindful of the full range of potential UWB parameters and characteristics when attempting to arrive at definitions of the technology and its applications, and must recognize that the familiar hallmarks of spectrum use may not be present or applicable in this case.

There is no question that the UWB's nature is a factor that only compounds the ill-advisedness of having NTIA design, debug, commence, and complete its measurement program within the span of six months. The Council, for one, is skeptical that NTIA, no matter how well intentioned, can conduct (on an extremely accelerated schedule using an admittedly incomplete sampling of UWB technology, no less) a study of sufficient comprehensiveness to allow it to avoid the risk of permitting self-interested parties to draw partial and potentially grievously overgeneralized conclusions about the technology's impact on the GPS system and its millions of users in hundreds of applications across all sectors of our economy.[10]

If the NTIA results are to provide the linchpin of the U.S. Government's assessment of the compatibility of UWB technology or subsets thereof with the GPS community, why is NTIA pursuing a testing schedule that it acknowledges will not provide it with any allowance for unforeseen measurement anomalies or to permit it to conduct proper analyses of the measurement data acquired absent a fundamental grounding in basic physical science to guide the testing strategy? If a credible and reliable result that will provide assurance to both UWB and GPS user communities is the ultimate objective, why then is NTIA, which is supposedly already one-third of the way into the six week period its schedule allows for the development and validation of software required for data acquisition, control, and data processing only now asking such questions as whether the UWB transmission system parameters it identifies representative of UWB devices envisioned for public use? The Council fully supports NTIA's role in a comprehensive testing program and the use of the test results and independent analyses to determine the regulatory mechanisms that are necessary to ensure that UWB transmission systems do not interfere with present and future GPS operations. The Council believes, however, that unless NTIA is given the funding it requires, the ability to adjust its measurement program to account for anomalies or gains in the scientific community's understanding of UWB, and the time to analyze and report itself upon the data it collects, the value of the NTIA measurement program

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conducted in light of UWB technologies; and what implications would the long-term spectrum requirements have for short-term regulatory decisions regarding UWB. *Id.* at 3. Notably, the National Research Council proposed that 18 months would be a sufficient time to completely analyze the technical, policy and regulatory aspects of UWB.

[9] The Council observes that UWB transmissions are similar to the early, unregulated uses of radio that created the chaos which led to the establishment of the Federal Radio Commission (precursor of the FCC) in 1927. The establishment of the FRC and later the FCC marked the shift in radio use from a time domain punctuated by wideband applications to the frequency domain that has been in place for nearly three quarters of a century.

[10] In this regard, the Council notes that it took the GPS experts at Stanford University nearly six months (from January 2000 until mid-July 2000) to debug the test sets and begin taking data for the ongoing measurement effort that Stanford and the Department of Transportation are jointly conducting with regard to UWB interference into GPS receivers that are used in particular aviation applications. NTIA will be working with a much broader class of GPS receivers under conditions where some of the same expertise with GPS applications is lacking, but has allowed only six weeks for a similar debugging exercise to be completed. *See* NTIA Measurement Plan at Table 5.

upon which comments were sought in the NTIA Notice will be significantly diminished over what it could otherwise be.

To this end, and recognizing the unique, honest-broker role NTIA can and should play in the compatibility assessments between potential UWB applications and GPS, the Council believes that the NTIA Measurement Plan should be fundamentally overhauled. Recognizing that NTIA is likely not be the organization that is best equipped or structured either to investigate or synthesize the theoretical understanding of the basic science of UWB, the peer-reviewed physical science understanding must be obtained elsewhere. Appropriate funding should be provided for the basic science investigation into UWB, and for a comprehensive measurement program that implements the results of that investigation. Opportunities for course corrections should be provided as experience is gained with tested UWB and GPS devices and potential anomalies in the results are revealed and compensated for, and a longer time table (which specifies the submission of a final report, replete with analyses, within one year from the date on which acquiescence to the extended approach is granted) should be adopted. Only with these modifications can NTIA's measurement program ascertain, with acceptable reliability, whether certain types of UWB applications are truly compatible with GPS. The burden, after all, remains on UWB proponents to demonstrate the ability of each of their proposed applications of UWB technology successfully to co-exist with GPS in its present and future incarnations, and with other existing services. The compressed timetable and associated short-cuts of the current NTIA Measurement Plan unfairly shift both the burden of proof and the risk of mistakes away from UWB proponents and to the GPS user community and other spectrum users. The Council remains hopeful that NTIA can prevail upon the regulatory authorities to remove the handcuffs that have been placed upon the agency before it is too late.

II. Technical Comments

The Council emphasizes again that it believes that NTIA, notwithstanding its absence of a physical science framework, and operating with limited resources and precious little time, has cobbled together a measurement program that is nearly as good as could possibly be expected under the circumstances. Although the Council plainly prefers the more thoughtful and rational approach it recommends in Section I of these Comments, the Council has made an effort to provide constructive suggestions that are compatible with the compressed time frame under which the NTIA measurement program is currently scheduled to be carried out. NTIA can take these suggestions on board without derailing its ongoing measurement effort. Even with these necessary modifications included, however, NTIA and parties intending to utilize the data gathered must recognize up front that NTIA's approach will mean that the data to be gathered will necessarily be profoundly limited in application. The Council's suggestions are provided below:

a. Completeness of of the List of Representative Candidate GPS Test Receivers

In its Measurement Plan, NTIA recognizes, probably correctly, that it cannot test all types of GPS receivers in the environments and under the conditions in which they are used. The list provided in Table 1 of the NTIA Measurement Plan is a good starting point.

The main concern about the receivers identified is that they are essentially all C/A-code non-military receivers. Although the list appropriately includes some cross-correlator type receivers for determining the dual frequency offset via P(Y)-code, the circuitry still essentially relies on

maintaining C/A-code track to function. Military receivers should be included for a number of reasons. The bandwidth of the P(Y)-code receivers will generally be broader than even the narrow-correlator-spacing type receivers (M-code receivers are expected to have bandwidths that are broader still). In addition, for reasons of signal security, direct-Y-code acquisition receivers have been/are being developed that exhibit the increased vulnerability to noise of the acquisition mode while having a broader bandwidth response. Considering that some military applications of UWB may involve co-site operation with GPS receivers, military GPS receivers should definitely be represented.

An additional concern on the completeness of the list of candidate GPS receivers is that the receiver applications are heavily weighted in favor of positioning applications. Although there is a representative timing receiver in the list, evidence should be provided that receivers, along with applications and specifications to support uses in the infrastructure of other systems, such as communication, power distribution, and finance, are taken into account in the measurement program.

In addition, NTIA's list does not include products that will be coming on the market shortly (such as the E-911 cellular devices with network-assisted GPS receivers that will be introduced in 2001 pursuant to an FCC rulemaking mandate[11]) and the personal location GPS devices anticipated for market introduction this year. These uses must be protected as well, but the impact of UWB on them cannot currently be measured. NTIA's final report should mention this shortcoming in particular, along with the general observation that there is no way a one-time measurement program for a single UWB waveform can ensure that the ever expanding array of uses of GPS – all of which are both encouraged and entitled to full protection from any UWB waveform – will in fact be protected.

b. Completeness of the List of Representative UWB Waveform Parameters

The NTIA Measurement Plan does not appear to encompass UWB waveform parameters that are representative of the UWB transmission systems that are envisioned for use by the public.[12] NTIA proposes to utilize only one UWB waveform, which is 0.5 nanoseconds in duration and a "burst of energy of ideally one positive going cycle (e.g., impulse)."[13] UWB waveforms have both positive- and negative-going harmonic components; can be of 0.5 to greater than 10 nanoseconds in duration; and have varying amounts of sinusoid (carrier) damping, depending on the driving signal and the transmitting antenna. If reliable results are to be obtained, NTIA must broaden the expected range of UWB waveforms and characterize them with respect to their envelope risetime, envelope damping, modulated harmonic components and time domain measurements of amplitude.

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[11] Some of the GPS receivers that will be used in conjunction with E-911 will feature Enhanced Sensitivity, which will enable them to work indoors. The Enhanced Sensitivity feature will, however, increase the receivers' susceptibility to interference.

[12] The Council is uncertain as to the significance in the NTIA Notice of the use of the term "envisioned for use by the public." *See* NTIA Notice, 65 Fed. Reg. at 49545. All UWB uses that produce energy into the GPS bands are of concern, and no artificial or policy limitation on the use of the devices should be employed as a screening mechanism at the testing stage of the policymaking process.

[13] *See* NTIA Measurement Plan, at Table 2 and page 1.

The UWB signal generator described in the NTIA Measurement plan may have the ability to generate one kind of the many kinds of pulses produced by a single ground penetration radar ("GPR") or through-the-wall imaging ("TWI") system. However, the testing proposed will not provide understanding concerning the cumulative interference effects resulting from the enormous variety of choices of interpulse-interval timing (coding) of trains of such pulses. A specific (but unknown) choice of interpulse-interval timing of trains of a specific (but unknown) UWB signal can provide an upset effect on the GPS C/A-code spectral lines, which cannot be predicted from an examination of either the individual pulse or a nonexhaustive selection of interpulse-interval codes for pulse trains.

The NTIA Measurement Plan is particularly deficient on the issue of the aggregation of UWB signals. Under the Plan, only one kind of UWB source is to be considered and the aggregated sources are to consist of only three signals.[14] There is no question, however, that aggregation of only three signals of a single kind would not constitute a reliable basis for the drawing of any technical conclusions. Furthermore, this will not demonstrate the degree of harm to the victim receiver from the synchronization effects of a communications network. It is clear that the signal generator does not have the ability to replicate communication applications of UWB.[15]

In short, the generator described by NTIA is incapable of simulating a single high-duty-cycle UWB device or the aggregate of numerous devices.[16] Moreover, the UWB generators described in this plan cannot possibly generate the kinds of aggregate emissions that approach Gaussian noise (which, as the FCC noted in the *FCC NPRM,* is exactly the kind of noise that may degrade GPS use at very long distances). Such aggregate effects can cause nonlinear effects in victim receivers due to the well-known finite relaxation time of receiver front-ends. These nonlinear effects cannot be probed by just three UWB signals. The inescapable conclusion is that, without significant expansion of the NTIA Measurement Plan and modifications to the equipment to be used, the data to be generated will not be able to be generalized beyond the specific, three-emitter aggregate scenario that is covered by the current NTIA plan.

On a separate issue, the NTIA Measurement Plan states that "[f]or these measurements, both broadband noise and UWB signal power will be expressed in average power density as

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[14] *See* NTIA Measurement Plan at 17, Table 4.

[15] There are several reasons why communication applications of UWB are, at present, inadequately represented with the use of the UWB generator described in the NTIA Measurement Plan: First, the maximum duty cycle of two percent is extremely low and would not take very good advantage of the large bandwidth potential of the system. In addition, even if individual UWB transmitters in a larger network are fairly characterized by pulses with a low duty cycle, the aggregate of the transmissions from the individual units would probably appear at times like a high duty-cycle emission.

[16] In Section 4.5 of the Measurement Plan, NTIA notes that there are only three UWB transmission systems available for this test. Even the properly phased combination of three units (the method pursuant to which this would be done is not described in the plan) would only produce a 6% duty cycle aggregate. A 6% duty cycle aggregate does not take advantage of the full potential for a local-area communication-network application. The limited duty cycle test also does not demonstrate the point where GPS receiver susceptibility to a pulsed signal increases markedly (at the 20 to 30% duty cycle point).

measured in 20-MHz bandwidth (dBm/20 MHz). Peak power can be determined from the APDs produced in the other ITS UWB measurement effort (see Section 3.1)."[17] The Council has serious difficulties with this statement, as the "20-MHz bandwidth" device will surely provide a filtered, averaged, and therefore inaccurate measurement.[18] Furthermore, the amplitude probability distribution ("APD") is only as good as the sampling rate of the test instrument taking the measurements required, and no definition of the referenced APD is provided in the Measurement Plan.[19] The Council notes that a sampling rate of 20 MHz (typical of present day spectrum analyzers) is inadequate to provide a power measure of a 0.5 nanosecond signal. To provide an adequate power measure, NTIA should therefore augment the spectrum analyzer with a time domain fast sample-and-hold oscilloscope that uses a 20 GHz sampling rate and samples at a Nyquist rate with respect to the UWB signal being analyzed.[20] This must be done with each GPS receiver tested. The actual techniques that NTIA intends to use are obscured by the statement that the techniques will be used in a post-measurement mode, "as appropriate."[21]

In short, although the Council supports NTIA's stated objective of identifying the UWB signal parameters to be considered, it concludes that the NTIA Measurement Plan does not, at present, fully address how to characterize a UWB signal in a way that permits creation of a thorough catalogue of UWB signals. In particular, NTIA must embrace an understanding of UWB that moves from the outmoded notion that models for continuous wave signals apply to UWB, and focus on the pulsed, transient nature of true UWB signals. These shortcomings should be corrected by NTIA, taking into account the theoretical foundation of the basic science, if the results to be generated are to be relied upon in any assessment of UWB compatibility with GPS.

c. Performance Metrics and Associated Criteria for GPS Receivers Used for Surveying, Maritime, and Recreational Applications

In its Measurement Plan, NTIA focuses exclusively on the loss of the first GPS satellite being tracked as the degradation metric. Clearly, the loss of the first satellite is a critical degradation metric, and NTIA is correct in testing for its occurrence. It is not, however, the only degradation metric. Other degradation metrics, which have differing significance depending on the application in which the GPS receiver is being used, include the following items, with the proper units in parentheses:

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17 *See* NTIA Measurement Plan at 9.

18 UWB signals, as the Council understands them, are not continuous wave, but rather are discontinuous wave (wave packet or pulse) systems with low duty cycles. In the latter case, the measure for predicting interference potential is the peak power.

19 The reference to Section 3.1 in the Measurement Plan yields no further information on this important subject.

20 In this regard, the Council notes that NTIA's Measurement Plan refers to the intended use of "high speed time domain equipment" (*see* Measurement Plan at 4), but there is no later description of this equipment. NTIA should provide a complete description of the equipment used to perform the measurements that will be conducted.

21 *See* NTIA Measurement Plan at 4.

No Fix, Outage Duration (seconds)
Cycle Slips per second
Cold Start (seconds)
Reacquisition while tracking N or more satellites (seconds)[22]
Pseudorange error, time of arrival, increase in Standard Deviation (nanoseconds)
Position error, increase in Standard Deviation Error (meters or centimeters, as appropriate)
Carrier-to-noise density ratio[23]
Code- and carrier-residuals (where available)

NTIA's measurements should report occurrences of each of these degradation metrics in the GPS receivers being analyzed. The failsafe point for each of these metrics (i.e., the point at which a customer's performance expectations can no longer be reliably met by GPS intended applications) differs from application to application and perhaps from manufacturer to manufacturer. Presentation of data on these degradation metrics in the report to be produced by NTIA, in addition to the loss-of-first-satellite metric, is critical because these metrics are more sensitive early indicators on impairment important to customer operations.[24] The impact of the data for particular applications can be addressed by individual commenters in their analyses of the data to be produced.

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[22] Public safety applications of GPS often rely on reacquisition time as a key criterion of integrity. Indeed, one –second time-to-alarm requirements for intelligent transportation systems have been cited by NTIA. See U.S. Department of Commerce, National Telecommunications and Information Administration, and U.S. Department of Transportation, *A Technical Report to the Secretary of Transportaion on a National Approach to Augmented GPS Services* (December 1994).

[23] Although this may not be a reliable measure of receiver stress in the presence of non-white noise, the test might be greatly speeded up if the calibration of the performance due to white (Gaussian) noise is obtained first and then compared to the effect from the UWB generator.

[24] Finally, the Council notes that there is a whole class of data items that are not available in off-the-shelf receivers but that may nevertheless be crucial in a comprehensive investigation of signal compatibility with GPS. This class of data, such as AGC level (to determine saturation effects), IF and baseband (pre-correlator) signal-to-noise, and tracking loop jitter, may be available only in a development-type or brassboard receiver. This kind of fundamental visibility into the impact of UWB signals to an 'instrumented' GPS receiver may be necessary to truly predict the effect of these essentially spurious signals on current and emerging receiver technologies.

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In conclusion, the Council is pleased to be able to provide these comments on the NTIA Measurement Plan, and respectfully urges their full consideration. The Council stands prepared to provide whatever information NTIA may desire as to any element of the foregoing discussion, and to offer any assistance NTIA may require as it carries out its Measurement Plan.

Respectfully submitted,

THE U.S. GPS INDUSTRY COUNCIL

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TECHNICAL CERTIFICATION

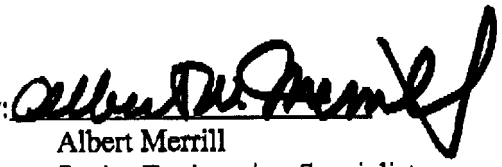
I, Steven K. Kaltenmark, hereby certify under penalty of perjury that I have either prepared or reviewed the technical information contained in the foregoing Comments of the U.S. GPS Industry Council, and that I find this information to be complete and accurate to the best of my knowledge and belief.

By: _____
Steven K. Kaltenmark
Telecomm Strategies

Dated: August 29, 2000

TECHNICAL CERTIFICATION

I, Albert Merrill, hereby certify under penalty of perjury that I have either prepared or reviewed the technical information contained in the foregoing Comments of the U.S. GPS Industry Council, and that I find this information to be complete and accurate to the best of my knowledge and belief.

By: 

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Dated: September 12, 2000